

Amendments to the Specification:

Please replace paragraph [08] with the following amended paragraph:

[08] A technique for forming three-dimensional structures (e.g. parts, components, devices, and the like) from a plurality of adhered layers was invented by Adam L. Cohen and is known as Electrochemical Fabrication. It is being commercially pursued by Microfabrica Inc. (formerly MEMGen® Corporation) of Burbank Van Nuys, California under the name EFAB™.® This technique was described in US Patent No. 6,027,630, issued on February 22, 2000. This electrochemical deposition technique allows the selective deposition of a material using a unique masking technique that involves the use of a mask that includes patterned conformable material on a support structure that is independent of the substrate onto which plating will occur. When desiring to perform an electrodeposition using the mask, the conformable portion of the mask is brought into contact with a substrate while in the presence of a plating solution such that the contact of the conformable portion of the mask to the substrate inhibits deposition at selected locations. For convenience, these masks might be generically called conformable contact masks; the masking technique may be generically called a conformable contact mask plating process. More specifically, in the terminology of Microfabrica Inc. (formerly MEMGen® Corporation) of Burbank Van Nuys, California such masks have come to be known as INSTANT MASKS™ and the process known as INSTANT MASKING™ or INSTANT MASK™ plating. Selective depositions using conformable contact mask plating may be used to form single layers of material or may be used to form multi-layer structures. The teachings of the '630 patent are hereby incorporated herein by reference as if set forth in full herein. Since the filing of the patent application that led to the above noted patent, various papers about conformable contact mask plating (i.e. INSTANT MASKING) and electrochemical fabrication have been published:

[28] An example of a CC mask and CC mask plating are shown in Figures 1(a)–1(e)FIGS. 1A–1C. FIG. 1AFigure 1(a) shows a side view of a CC mask 8 consisting of a conformable or deformable (e.g. elastomeric) insulator 10 patterned on an anode 12. The anode has two functions. FIG. 1AFigure 1(a) also depicts a substrate 6 separated from mask 8. One is as a supporting material for the patterned insulator 10 to maintain its integrity and alignment since the pattern may be topologically complex (e.g., involving isolated “islands” of insulator material). The other function is as an anode for the electroplating operation. CC mask plating selectively deposits material 22 onto a substrate 6 by simply pressing the insulator against the substrate then electrodepositing material through apertures 26a and 26b in the insulator as shown in FIG.

~~1B~~Figure 1(b). After deposition, the CC mask is separated, preferably non-destructively, from the substrate 6 as shown in ~~FIG. 1C~~Figure 1(e). The CC mask plating process is distinct from a “through-mask” plating process in that in a through-mask plating process the separation of the masking material from the substrate would occur destructively. As with through-mask plating, CC mask plating deposits material selectively and simultaneously over the entire layer. The plated region may consist of one or more isolated plating regions where these isolated plating regions may belong to a single structure that is being formed or may belong to multiple structures that are being formed simultaneously. In CC mask plating as individual masks are not intentionally destroyed in the removal process, they may be usable in multiple plating operations.

Please replace paragraph [29] with the following amended paragraph:

[29] Another example of a CC mask and CC mask plating is shown in FIGS. 1D – 1F~~Figures 1(d) – 1(f)~~. FIG. 1D~~Figure 1(d)~~ shows an anode 12' separated from a mask 8' that includes a patterned conformable material 10' and a support structure 20. FIG. 1D~~Figure 1(d)~~ also depicts substrate 6 separated from the mask 8'. FIG. 1E~~Figure 1(e)~~ illustrates the mask 8' being brought into contact with the substrate 6. FIG. 1F~~Figure 1(f)~~ illustrates the deposit 22' that results from conducting a current from the anode 12' to the substrate 6. FIG. 1G~~Figure 1(g)~~ illustrates the deposit 22' on substrate 6 after separation from mask 8'. In this example, an appropriate electrolyte is located between the substrate 6 and the anode 12' and a current of ions coming from one or both of the solution and the anode are conducted through the opening in the mask to the substrate where material is deposited. This type of mask may be referred to as an anodeless INSTANT MASK™ (AIM) or as an anodeless conformable contact (ACC) mask.

Please replace paragraph [31] with the following amended paragraph:

[31] An example of the electrochemical fabrication process discussed above is illustrated in FIGS. 2A – 2F~~Figures 2(a) – 2(f)~~. These figures show that the process involves deposition of a first material 2 which is a sacrificial material and a second material 4 which is a structural material. The CC mask 8, in this example, includes a patterned conformable material (e.g. an elastomeric dielectric material) 10 and a support 12 which is made from deposition material 2. The conformal portion of the CC mask is pressed against substrate 6 with a plating

solution 14 located within the openings 16 in the conformable material 10. An electric current, from power supply 18, is then passed through the plating solution 14 via (a) support 12 which doubles as an anode and (b) substrate 6 which doubles as a cathode. FIG. 2AFigure 2(a), illustrates that the passing of current causes material 2 within the plating solution and material 2 from the anode 12 to be selectively transferred to and plated on the cathode 6. After electroplating the first deposition material 2 onto the substrate 6 using CC mask 8, the CC mask 8 is removed as shown in FIG. 2BFigure 2(b). FIG. 2CFigure 2(c) depicts the second deposition material 4 as having been blanket-deposited (i.e. non-selectively deposited) over the previously deposited first deposition material 2 as well as over the other portions of the substrate 6. The blanket deposition occurs by electroplating from an anode (not shown), composed of the second material, through an appropriate plating solution (not shown), and to the cathode/substrate 6. The entire two-material layer is then planarized to achieve precise thickness and flatness as shown in FIG. 2DFigure 2(d). After repetition of this process for all layers, the multi-layer structure 20 formed of the second material 4 (i.e. structural material) is embedded in first material 2 (i.e. sacrificial material) as shown in FIG. 2EFigure 2(e). The embedded structure is etched to yield the desired device, i.e. structure 20, as shown in FIG. 2FFigure 2(f).

Please replace paragraph [32] with the following amended paragraph:

[32] Various components of an exemplary manual electrochemical fabrication system 32 are shown in FIGS. 3A – 3CFigures 3(a) – 3(c). The system 32 consists of several subsystems 34, 36, 38, and 40. The substrate holding subsystem 34 is depicted in the upper portions of each of FIGS. 3A – 3CFigures 3(a) to 3(c) and includes several components: (1) a carrier 48, (2) a metal substrate 6 onto which the layers are deposited, and (3) a linear slide 42 capable of moving the substrate 6 up and down relative to the carrier 48 in response to drive force from actuator 44. Subsystem 34 also includes an indicator 46 for measuring differences in vertical position of the substrate which may be used in setting or determining layer thicknesses and/or deposition thicknesses. The subsystem 34 further includes feet 68 for carrier 48 which can be precisely mounted on subsystem 36.

Please replace paragraph [33] with the following amended paragraph:

[33] The CC mask subsystem 36 shown in the lower portion of FIG. 3AFigure 3(a) includes several components: (1) a CC mask 8 that is actually made up of a number of CC

masks (i.e. submasks) that share a common support/anode 12, (2) precision X-stage 54, (3) precision Y-stage 56, (4) frame 72 on which the feet 68 of subsystem 34 can mount, and (5) a tank 58 for containing the electrolyte 16. Subsystems 34 and 36 also include appropriate electrical connections (not shown) for connecting to an appropriate power source for driving the CC masking process.

Please replace paragraph [34] with the following amended paragraph:

[34] The blanket deposition subsystem 38 is shown in the lower portion of FIG. 3B ~~Figure 3(b)~~ and includes several components: (1) an anode 62, (2) an electrolyte tank 64 for holding plating solution 66, and (3) frame 74 on which the feet 68 of subsystem 34 may sit. Subsystem 38 also includes appropriate electrical connections (not shown) for connecting the anode to an appropriate power supply for driving the blanket deposition process.

Please replace paragraph [35] with the following amended paragraph:

[35] The planarization subsystem 40 is shown in the lower portion of FIG. 3C ~~Figure 3(c)~~ and includes a lapping plate 52 and associated motion and control systems (not shown) for planarizing the depositions.

Please replace paragraph [58] with the following amended paragraph:

[58] In a seventeenth aspect of the invention ~~a an~~ apparatus for forming a multilayer three-dimensional structure includes: (a) a substrate on which one or more successive depositions of one or more materials may have occurred and will occur; (b) a mask that comprises at least one void and at least one surrounding protrusion of material; (c) a stage for bringing the at least one protrusion of the mask into a proximity but not completely contacting position with the substrate so as to form at least one an electrochemical process pocket having a desired registration with respect to any previous depositions and providing a desired electrolyte within the at least one electrochemical process pocket; (d) a power supply for applying a desired electrical activation between at least one electrode, that may be part of the mask or separate therefrom, and the substrate, such that a desired modification of the substrate occurs; and (e) at least one controller for controlling the stage and the power supply.

Please replace paragraph [68] with the following amended paragraph:

[68] FIGS. 1A – 1C~~Figures 1(a) – 1(c)~~ schematically depict side views of various stages of a CC mask plating process, while FIGS. 1D – 1G~~Figures 1(d) – (g)~~ schematically depict a side views of various stages of a CC mask plating process using a different type of CC mask.

Please replace paragraph [69] with the following amended paragraph:

[69] FIGS. 2A – 2F~~Figures 2(a) – 2(f)~~ schematically depict side views of various stages of an electrochemical fabrication process as applied to the formation of a particular structure where a sacrificial material is selectively deposited while a structural material is blanket deposited.

Please replace paragraph [70] with the following amended paragraph:

[70] FIGS. 3A – 3C~~Figures 3(a) – 3(c)~~ schematically depict side views of various example subassemblies that may be used in manually implementing the electrochemical fabrication method depicted in FIGS. 2A – 2F~~Figures 2(a) – 2(f)~~.

Please replace paragraph [71] with the following amended paragraph:

[71] FIGS. 4A – 4I~~Figures 4(a) – 4(i)~~ schematically depict the formation of a first layer of a structure using adhered mask plating where the blanket deposition of a second material overlays both the openings between deposition locations of a first material and the first material itself.

Please replace paragraph [72] with the following amended paragraph:

[72] FIG. 5~~Figure 5~~ depicts a mask useable with certain embodiments of the invention where the mask includes two materials.

Please replace paragraph [73] with the following amended paragraph:

[73] FIG. 6Figure 6 depicts a mask useable with certain embodiments of the invention where the mask includes three materials.

Please replace paragraph [74] with the following amended paragraph:

[74] FIGS. 1A – C, 2A – 2F, and 3A – 3CFigures 1(a) – 1(c), 2(a) – 2(f), and 3(a) – 3(c) illustrate various aspects of electrochemical fabrication that are known. Other electrochemical fabrication techniques are set forth in the '630 patent, in the various previously incorporated publications, in patent applications incorporated herein by reference, still other may be derived from combinations of various approaches described in these publications, patents, and applications, or are otherwise known or ascertainable by those of skill in the art. All of these techniques may be combined with those of the present invention to yield enhanced embodiments.

Please replace paragraph [75] with the following amended paragraph:

[75] FIGS. 4A – 4HFigures 4(a) – 4(h) illustrate various stages in the formation of a single layer of a multi-layer fabrication process where a second metal is deposited on a first metal as well as in openings in the first metal where its deposition forms part of the layer. In FIG. 4AFigure 4(a), a side view of a substrate 82 is shown, onto which patternable photoresist 84 is cast as shown in FIG. 4BFigure 4(b). In FIG. 4CFigure 4(c), a pattern of resist is shown that results from the curing, exposing, and developing of the resist. The patterning of the photoresist 84 results in openings or apertures 92(a) - 92(c) extending from a surface 86 of the photoresist through the thickness of the photoresist to surface 88 of the substrate 82. In FIG. 4DFigure 4(d), a metal 94 (e.g. nickel) is shown as having been electroplated into the openings 92(a) - 92(c). In FIG. 4EFigure 4(e), the photoresist has been removed (i.e. chemically stripped) from the substrate to expose regions of the substrate 82 which are not covered with the first metal 94. In FIG. 4FFigure 4(f), a second metal 96 (e.g., silver) is shown as having been blanket electroplated over the entire exposed portions of the substrate 82 (which is conductive) and over the first metal 94 (which is also conductive). FIG. 4GFigure 4(g) depicts the completed first layer of the structure which has resulted from the planarization of the first and second metals down to a height that exposes the first metal and sets a thickness for the first layer. In FIG. 4HFigure 4(h) the result of repeating the process steps shown in FIGS. 4B – 4GFigures 4(b) – 4(g) several times to form a multi-layer structure are shown where each layer consists of two

materials. For most applications, one of these materials is removed as shown in FIG. 4 ~~Figure 4(i)~~ to yield a desired 3-D structure 98 (e.g. component or device).

Please replace paragraph [77] with the following amended paragraph:

[77] FIG. Figure 5 schematically depicts a side view of an example of a mask according to a first set of embodiments of the invention where the mask 102 includes at least two materials, a first material 104 for a support portion 106 of the mask, and a second material 108 for a protruding portion 110 of the mask where the protrusion surrounds (or defines) openings (or voids) 442122. In this example the first material has a first flexibility (i.e. deformability or conformability) and the second material has a second flexibility.

Please replace paragraph [78] with the following amended paragraph:

[78] In a first implementation of the mask of FigureFIG. 5, the first material may have a flexibility greater than that of the second material. For example the first material may be flexible while the second material is semi-flexible or even relatively rigid. Alternatively the first material may be semi-flexible while the second material is rigid. The flexibility and rigidity of the material as described herein refers to the degree of conformability (i.e. plasticity) or lack thereof of the materials when undergoing mating pressures used for sealing (e.g. 1 to 100 PSI).

Please replace paragraph [82] with the following amended paragraph:

[82] FigureFIG. 6 depicts an example of a mask according to a second embodiment of the invention where the mask 202 includes at least three materials, a first material 204 for a support portion 206 of the mask, a second material 208 for the intermediate protruding portion 210 of the mask where the protrusion partially surrounds (or defines) openings (or voids) 222 and, a third material 212 for the outward protruding portion 214 of the mask. In this example the first material has a first flexibility (i.e. deformability or conformability), the second material has a second flexibility, and the third material has a third flexibility.

Please replace paragraph [83] with the following amended paragraph:

[83] In a first implementation of the mask of ~~Figure~~FIG. 6, the second material may have a flexibility that is greater than the flexibility of either of the first or third materials. For example, the flexibility of the first, second, and third materials (first--second--third) may, respectively, be: (1) rigid--semi-flexible--rigid, (2) rigid--flexible--rigid, (3) semi-flexible--flexible--semi-flexible, (4) rigid--flexible--semi-flexible, or (5) semi-flexible--flexible--rigid.

Please replace paragraph [88] with the following amended paragraph:

[88] When the first material is flexible or semi-flexible, it may be possible to manipulate the mask shape during mating and un-mating with the substrate such that mating may occur in a manner so as to leave paths for excess electrolyte to escape (e.g. when the mask is mated to the substrate from one side and then working to the other side; when the mask is mated to the substrate first in the center and mating is continued by working toward the sides, or when the mating may occur in a geometry sensitive manner). Similarly when removing the mask from a mated position it may be possible to flex the mask to cause unsealing to occur from one edge first and then have it propagate to the other edge or from all edges and then to the center. In embodiments where the flexing or flexibility of the first material will be used in either mating or un-mating masks and substrate, the masks may be of either the two-part configuration (i.e. ~~Figure~~FIG. 5), the three-part configuration (i.e. ~~Figure~~FIG. 6), or of some other configuration. In such embodiments, the mask material that mates with the substrate may have a flexibility that is equal to that of the other materials, less than that of the other materials, or even greater than that of the other materials.

Please replace paragraph [95] with the following amended paragraph:

[95] In alternative embodiments, the masks described above may be of the anode-less or electro-less type. Such masks were described herein above in association with FIGS. 1D – 1G~~Figures 1(d) – 1(g)~~. They are described in US Patent 6,027,630, referenced herein above as well as in US Patent Application Nos. 60/429,483 and 10/677,498. The former of which was filed on November 26, 2002 while the later was filed on October 1, 2003. Both were filed by Adam L. Cohen, et al. and were entitled "Multi-Cell Masks and Methods and Apparatus for Using Such Masks To Form Three-Dimensional Structures". Both of these patent applications are incorporated herein by reference as if set forth in full.

Please replace paragraph [98] with the following amended paragraph:

[98] The masks, masking techniques, and structure formation techniques disclosed explicitly herein may benefit by using the enhanced mask mating techniques disclosed in US Patent Application No. ~~60/525,797??/???,???~~ (Microfabrica Docket No. P-US022-A-MF) filed ~~concurrently herewith~~ November 26, 2003 by Jeffrey A. Thompson and entitled "EFAB Methods Including Controlled Mask to Substrate Mating". This referenced application is incorporated herein by reference as if set forth in full herein. This referenced application teaches the treatment of substrates, formation of structures, and formation of multilayer structures using contact masks where a controlled mating of contact masks and substrates is used. Some embodiments involve controlled mating at speeds equal to or less than 10 microns/second, more preferably equal to or less than 5 microns/second, and even more preferably equal to or less than 1 micron/second. Some embodiments involve controlled mating that uses a higher speed of approach when further away and a slower speed of approach to cause mating. Some embodiments involve controlled mating that uses a higher speed of approach when making a preliminary contact, then backing away a desired distance, and then making a mating approach that cause mating while using a slower mating speed.

Please replace paragraph [99] with the following amended paragraph:

[99] The masks, masking techniques, and structure formation techniques disclosed explicitly herein may benefit by using the enhanced mask mating techniques disclosed in US Patent Application No. ~~10/724,515??/???,???~~ (Microfabrica Docket No. P-US024-A-MF) filed ~~concurrently herewith~~ November 26, 2003 by Adam L. Cohen et al. and entitled "Method for Electrochemically Forming Structures Including Non-Parallel Mating of Contact Masks and Substrates". This referenced application is incorporated herein by reference as if set forth in full herein. This referenced application teaches the treatment of substrates, formation of structures, and formation of multilayer structures using contact masks where a non-parallel or non-simultaneous mating and/or un-mating of various mask contact surfaces to a substrate surface occurs. Some embodiments involve bringing a relative planar mask contact surface and a relative planar substrate surface together at a small angle (but larger than an alignment tolerance associated with the system). Some embodiments involve flexing a mask to make it non-planar and bringing it into contact with a substrate such that progressively more contact between the mask and substrate occur until complete mating is achieved.